



UNIVERSITÀ
DEGLI STUDI
FIRENZE

FLORE

Repository istituzionale dell'Università degli Studi di Firenze

Ground Penetrating Radar with Contact Horn Antennas

Questa è la Versione finale referata (Post print/Accepted manuscript) della seguente pubblicazione:

Original Citation:

Ground Penetrating Radar with Contact Horn Antennas / Pieraccini, Massimiliano; Rojhani, Neda; Miccinesi, Lapo. - ELETTRONICO. - (2017), pp. 0-0. (Intervento presentato al convegno 32nd URSI GASS, Montreal, 19-26 August 2017).

Availability:

This version is available at: 2158/1094662 since: 2017-09-19T15:50:38Z

Publisher:

International Union of Radio Science General Assembly

Terms of use:

Open Access

La pubblicazione è resa disponibile sotto le norme e i termini della licenza di deposito, secondo quanto stabilito dalla Policy per l'accesso aperto dell'Università degli Studi di Firenze (<https://www.sba.unifi.it/upload/policy-oa-2016-1.pdf>)

Publisher copyright claim:

(Article begins on next page)



Ground Penetrating Radar with Contact Horn Antennas

Massimiliano Pieraccini⁽¹⁾, Neda Rojhani⁽¹⁾, and Lapo Miccinesi⁽¹⁾

(1) Department of Information Engineering, University of Florence, via Santa Marta, 3 50139 Firenze

1. Introduction

Ground Penetrating Radars (GPR) are popular instruments able to investigate the ground through electromagnetic waves. They are commonly used for detecting pipes under the floor or the asphalt [1], buried ancient artifacts [2] or parts of ancient buildings [3], as well as in many other applications [4].

A key element of any GPR is the antenna. While the antennas for TLC are designed for operating in the free space, the antennas for GPR must operate close or in contact of the ground. This is a strict constraint in their design. Coupling of antenna with the soil is key point. Furthermore, they have to be well-shielded in the back for avoiding to detect "air events", i.e. targets in the air that can be confused with targets in the subsurface. Many different antennas are proposed and tested for GPR [4], but bow-tie are probably the most used [5]-[13]. Their simple and robust design makes them effective in most applications.

Nevertheless bow-tie antenna have some important drawbacks: 1) their lobe is large, so the power is spread in a large solid angle reducing the penetration depth; 2) the coupling between TX and RX antennas is high; 3) the efficiency is reduced by the absorbing material on the back. The contact horn antenna could overcome them: 1) the lobe is narrower (using the same band); 2) the direct coupling is lower; 3) it does not need absorbing materials.

Therefore the aim of this paper is to model a horn antenna in contact with the soil, and to test it also in comparison with a bow-tie antenna operating in the same band. Furthermore, for improving the coupling between horn antenna and soil and to extend its lower band, the empty space inside the horn will be filled with a dielectric oil. Even in this configuration the antenna will be modeled and tested in order to assess its performances

4. References

- [1] C. Windsor, L. Capineri, P. Falorni, S. Matucci, G. Borgioli, "The estimation of buried pipe diameters using ground penetrating radar." *Insight-Non-Destructive Testing and Condition Monitoring*, Vol. 47, No. 7, pp. 394-399, 2005
- [2] L. B. Conyers, "Ground-penetrating radar for archaeology." Altamira Press, 2013.
- [3] F. Grasso, G. Leucci, N. Masini, R. Persico. "GPR prospecting in Renaissance and baroque monuments in Lecce (Southern Italy)." In *Advanced Ground Penetrating Radar (IWAGPR)*, 2011 6th International Workshop on (pp. 1-4), June, 2011.
- [4] D. J. Daniels, "Ground penetrating radar." John Wiley & Sons, Inc., 2005.
- [5] S. G. Millard, A. Shaari, J. H. Bungey. "Field pattern characteristics of GPR antennas." *NDT & E International*, Vol. 35 No. 7, pp. 473-482 October 2002
- [6] F. Parrini, M. Pieraccini, D. Mecatti, D. Dei, G. Macaluso, A. Spinetti, R. Persico, G. Leucci, G. Manacorda, "A reconfigurable stepped frequency GPR (GPR-R): The antenna subsystem. In 2013 7th International Workshop on Advanced Ground Penetrating Radar. July 2013.
- [7] F. Parrini, F. Papi, M. Pieraccini. "An ultra high resolution stepped frequency GPR for civil engineering applications." *Advanced Ground Penetrating Radar (IWAGPR)*, 2015 8th International Workshop on. IEEE, 2015.
- [8] A. G. Yarovoy, L. P. Ligthart. "Ultra-wideband antennas for ground penetrating radar." *Proc. International Symposium on Antennas for Radar Earth Observation, Symposium*, Delft University of Technology, The Netherlands. 2000.
- [9] G. Chen, R. C. Liu. "A 900MHz shielded bow-tie antenna system for ground penetrating radar." *Ground Penetrating Radar (GPR)*, 2010 13th International Conference on. IEEE, 2010.
- [10] B. Panzner, A. Jöstingmeier, A. Omar. "A compact double-ridged horn antenna for ground penetrating radar applications." *Microwave Radar and Wireless Communications (MIKON)*, 2010 18th International Conference on. IEEE, 2010.
- [11] T. A. Serdar, A. K. Keskin. "Ultra wide band TEM horn antenna designs for ground penetrating impulse radar." *2012 IEEE International Conference on Ultra-Wideband*. IEEE, 2012.
- [12] A. G. Emam, A. A. Shaalan, K. F. Ahmed Hussein. "Wideband partially-covered bowtie antenna for ground-penetrating-radars." *Progress In Electromagnetics Research* Vol. 71, pp. 211-226, 2007
- [13] T. Saarenketo, T. Scullion. "Road evaluation with ground penetrating radar." *Journal of applied geophysics*, Vol. 43. No. 2, pp. 119-138, 2000